

REMARKS

Review and reconsideration on the merits are requested.

Formalities

Applicants appreciate the Examiner accepting the drawings, acknowledging receipt of certified copies of the priority documents (there are two priority documents) and returning two initialed PTO/SB/08 Forms as indicated on the bottom of **Office Action Summary**.

Basis for Claim Amendments

With respect to the from 2 to 14 wt% as an amount based on carbon and the carbon being derived from an organic acid (the amount of carbon) see the specification at page 23, second full paragraph to page 24 first full paragraph, making it clear that the Group 8 metal forms a complex compound with the organic acid on the catalyst, i.e., the organic acid is present.

With respect to the 0.2 to 1.2 mols limitation, this finds support at page 32, third full paragraph of the specification.

With respect to changing the minimum average pore diameter from 65 Å to 96 Å, see the paragraph bridging pages 26-27 of the specification..

Applicants first address the art rejections and then address the obviousness-type double patenting rejections.

The Prior Art

US 5,397,456 Dai et al (Dai); US 6,559,092 Dufresne et al (Dufresne); the Payen article (Payen).

The Rejections

Claims 1, 2, 5 and 6 under 35 U.S.C. § 103(a) as being unpatentable over Dai in view of Dufresne. Paragraph 9 of the Action.

Claims 3 and 4 under 35 U.S.C. § 103(a) as being unpatentable over Dai in view of Dufresne as applied to claims 1, 2, 5 and 6 and further in view of Payen. Paragraph 10 of the Action.

The Examiner's reading of the prior art and the application of the prior art to claims herein is set forth in the Action and will not be repeated here in detail except as necessary to an understanding of Applicants' traversal which is now presented.

Traversal

Amendments to Claim 1 and Claim 5

Applicants first focus on the amendment to claim 1 calling for "wherein the organic acid is contained in an amount of from 0.2 to 1.2 mols relative to 1 mol of the metal of Group 8 of the periodic table" (claim 1) or "in such a manner that a molar ratio of organic acid/Group 8 metal of the periodic table is from 0.2 to 1.2" (claim 5).

These are important limitations to the present invention, and Applicants now explain in detail how they render the claims herein unobvious over the prior art.

Applicants rely upon the arguments for claim 1 to establish the patentability of claims 2-6.

A major factor in accordance with the present invention is to add an organic acid to form a complex with a Group 8 metal, and to add the organic acid in a predetermined yet optimum amount.

To retain the complex of an organic acid and the Group 8 metal even after drying, it is necessary to perform drying at a temperature that will not liberate the organic acid from the catalyst. Thus, in accordance with the present invention, in the catalyst of the present invention carbon exists or is present in the form of an organic acid.

Adding the organic acid in excess causes an increase in the viscosity of the depositing solution which contains active metal, phosphoric acid and organic acid. As a result, in addition to creating problems in handling, it becomes impossible to deposit the active metal in a highly dispersed state on the support. As a consequence, active sites are not formed uniformly after the sulfurization and the desired activity cannot be achieved. Thus, the amount of organic acid relative to one mole of the metal of Group 8 of the periodic table is also important.

Against the above background, Applicants turn to the prior art.

Dai

A first key difference is that in accordance with the present invention, the catalyst contains an organic acid as a defined amount of carbon. A further important difference is that in the catalyst, the molar ratio of the organic acid to the metal of Group 8 is within a specific numerical range, namely from 0.2 to 1.2, whereby the desulfurization activity sites (CoMoS, NiMoS, etc.) are well formed and, as a result, a highly active catalyst as compared with conventional catalysts can be obtained.

In distinction, in Dai, although the physical properties of a Dai catalyst are disclosed for a hydrogenating treatment catalyst for hydrocarbon oils, there is no disclosure in Dai regarding carbon and, as a consequence, there is no disclosure of an organic acid expressed as a defined amount of carbon and molar ratio of organic acid to metal of Group 8.

Dufresne

Dufresne discloses that an organic acid is useful as a carbon source, but the gist of using an organic acid as a carbon source in Dufresne is to decompose the carbon source and deposit the same as solid carbon.

The catalyst disclosed in Dufresne comprises hydrocarbons, alcohols, organic acids and the like as raw materials, but the main feature of Dufresne is to decompose the carbon source and deposit the same as solid carbon.

Since solid carbon deposited on a catalyst is incapable of forming a complex with a Group 8 metal, the concept of catalyst design is completely different in Dufresne from that of the present invention.

In distinction, Dufresne is directed to suppressing catalyst deactivation by reducing the acidity of the catalyst support using the solid carbon deposited on the catalyst, which will result in extending the service life of the catalyst. However, Dufresne does not describe or suggest the concept of the present invention which is directed to causing an organic acid to form a complex with a Group 8 metal, thereby effectively forming active catalytic sites.

Even if one of ordinary skill in the art were to combine Dai with Dufresne, that person of ordinary skill in the art is still not led to the present invention which involves a catalyst having a high desulfurizing effect; this logically follows as there is no disclosure of an organic acid which is present and which is expressed as a defined amount of carbon or disclosure of the molar ratio of organic acid to metal of Group 8 (from 0.2 to 1.2) in Dai or Dufresne.

Payen

Payen does not disclose the use of an organic acid (a chelating agent) as the carbon source, and conducts no high temperature burning after supporting an organic acid.

The number of laminated layers of MoS₂ is disclosed in Table 2 of Payen, and does partially overlap with the range defined in the present application. Further, in Table 2 of Payen, the in-plane-direction length of MoS₂ is disclosed, and in fact partially overlaps with the range defined in the present application.

However, the preparation method for the catalyst in Payen comprises burning at 500°C after supporting Mo and Co (Ni) on an aluminum support, and is completely different from that of the present invention.

Applicants respectfully submit that since Dai and Dufresne do not disclose the essential features of the present invention, and claims 3 and 4 depend from claim 1, even if Dai and Dufresne are combined with Payen, one of ordinary skill in the art is not led to the present claims.

Form of Organic Acid or Carbon after Drying

As will be explained in more detail in the following discussion, which is relevant regarding the disclosure in Dufresne, the organic acid remains as it is, forming a complex with a Group 8 metal.

This is especially important with respect to Dufresne and the results achieved in accordance with the present invention since Dufresne is a secondary reference relied upon to support all rejections. Dufresne discloses, at col. 1, lines 39-49, that the aim of the Dufresne invention is to carryout pre-sulfurization of the Dufresne catalyst in the presence of hydrogen, etc.

Dufresne teaches at column 1, line 44-48 that the Dufresne invention is: “characterized in that in order to improve the catalytic performances in the hydrotreatment reactions, the catalyst is **pre-carbonized so as to deposit solid carbon in the pores of the catalyst**, the major portion of said carbon being nonleachable.” (bold added)

Against the above background, a major factor in accordance with the present invention is to add an organic acid to form a complex with a Group 8 metal, and to add the organic acid in an optimum amount.

To retain the complex of organic acid and Group 8 metal even after drying, it is necessary to execute drying at a temperature which does not cause liberation of the organic acid from the catalyst. Thus, in the catalyst of the present invention, carbon exists in the form of an organic acid.

In contrast, the catalyst disclosed in Dufresne uses hydrocarbons, alcohols, organic acids and the like as the raw material, but is predicted on decomposing the carbon source and depositing it as solid carbon.

Since solid carbon deposited on the catalyst is incapable of forming a complex with a Group 8 metal, the concept of catalyst designing in Dufresne is entirely different from that of the present invention.

Thus, in distinction to Dufresne, in accordance with the present invention the organic acid which forms a complex with the Group 8 metal is not in the form of solid carbon as in Dufresne.

Discussion in the Specification Relating to “Containing Organic Acid at from 2 to 14 wt % as Carbon, Based on the Catalyst” or “an Organic Acid at from 2 to 14 wt% as an Amount of Carbon Based on the Catalyst”

At pages 23 and 24 et seq of the specification, it is disclosed that the organic acid forms a complex with the Group 8 metal.

At page 36 of the specification, it is disclosed that the organic acid will be released or liberated from the catalyst by performing a drying at a temperature higher than 200°C. Based on this disclosure, one of ordinary skill in the art would understand that the organic acid forms, as it is, a complex with a Group 8 metal, even after drying.

State of Carbon

The Examiner appreciates that Dai does not disclose the carbon content of the catalyst and does not disclose an organic acid expressed as an amount of carbon. (Action, page 8, 2nd full paragraph) However, the Examiner concludes that combining Dai with Sherwood this requirement of the claims at the present application would be rendered obvious.

Dufresne quite clearly teaches that any organic acid used as a raw material is decomposed and deposited as solid carbon, quite in distinction to the present invention.

Further, it is to be noted that Dufresne intends to suppress the activation of the catalyst by reducing the acidity of the support by the solid carbon deposited on the catalyst, thereby extending the service life of the catalyst. However, Dufresne in no fashion suggests the basic concept of the present invention which is to cause the organic to form a complex with a Group 8 metal, thereby effectively forming active sites.

Claim 1 recites that the organic acid is present in an amount defined as carbon, which is not taught or suggested by the references. Further, characteristic features of the present invention include: (1) the use of an organic acid (a chelating agent), and (2) conducting no high temperature burning during catalyst preparation. An organic acid is characterized by forming a complex with a Group 8 metal. Namely, since the Group 8 metal complexed with the organic acid in the preliminary sulfidation step is sulfidated slower than the Group 6 metal, desulfurization active sites (CoMoS phase, NiMoS phase, etc.) are sufficiently formed, and at the same time, Co₉S₈ and Ni₃S₂, which are inactive forms of cobalt and nickel, are not formed. As a result, a remarkably more active catalyst than conventional ones can be obtained.

None of Dai, Dufresne or Payen discloses, teaches or suggests the use of an organic acid (a chelating agent) in a specified amount defined as carbon, and conducting no high temperature

burning after supporting an organic acid. Thus, even if these references were combined the present invention would not have been achieved since the combination of these references does not lead to the idea of the present invention that active sites are effectively formed during the sulfidation of the catalyst by using an organic acid for supporting an active metal and conducting no burning at an elevated temperature.

The present invention is characterized in that an organic acid and a Group 8 metal form a complex on the catalyst. Namely, since the Group 8 metal complexed with the organic acid during the preliminary sulfidation step is sulfided slower than the Group 6 metal, desulfurization active sites (CoMoS phase, NiMoS phase, etc.) are sufficiently formed, and at same time, Co_9S_8 and Ni_3S_2 , which are inactive forms of cobalt and nickel, are not formed.

Claim 3

Applicants note that the number of the laminated layers of MoS_2 is described in Table 2 of Payen and partially overlaps the range defined by the present invention. However, the preparation method for the catalyst in Payen et al comprises burning at 500°C after supporting Mo and Co (Ni) on an alumina support, and is completely different from that of the present invention. Therefore, there is no motivation for one of ordinary skill in the art to modify or combine the references to arrive at the present invention. For this additional reason, claim 3 is distinguished over the cited art.

Claim 4

With respect to claim 4, the Examiner states that in Table 2 of Payen, the in-plane-direction length of MoS_2 is described, which partially overlaps with the range defined by the present invention. However, the preparation method for the catalyst in Payen comprises burning at 500°C after supporting Mo and Co (Ni) on an alumina support, and is completely different

from that of the present invention. Therefore, there is no motivation to combine Dai, Dufresne and Payen to arrive at the present invention. For this additional reason, claim 4 is distinguished over the art.

Claim 5

The reason for the addition of an organic acid (chelating agent) in the present invention is to have the organic acid coordinated to a Group 8 metal to form a chelate compound (a complex compound). During the preliminary sulfidation step, the Group 6 metal (for example, molybdenum) is sulfided at first and a layer structure of molybdenum sulfide is sufficiently formed. Thereafter, the complex compound of Group 8 metal having a high decomposition temperature is gradually decomposed whereby the CoMoS phase and NiMoS phase, which are desulfurization active sites, are formed at the rim-edge portion of MoS₂.

From a review of Dai, it appears that Dai does not contemplate any type of organic additives. Accordingly, one of ordinary skill in the art reviewing Dai would not be led to add an organic acid for the present invention to a Dai system without any knowledge of what might happen.

In the present invention, it is essential for an organic acid to combine with Co²⁺ cation. Desulfurization active sites cannot be sufficiently formed since the Group 6 metal and the Group 8 metal are sulfided simultaneously during the preliminary sulfidation step due to no compound formation of the Group 8 metal. Furthermore, formation of Co₉S₈, Ni₃S₂, etc., which are inactive forms of cobalt and nickel, is likely to occur.

The present invention also has different effects from that of Dai. The catalyst evaluation conditions in the examples and the comparative examples of the present invention and Dai are not the same. Nevertheless, the superiority of the catalyst according to the present invention can

be inferred from the technical differences mentioned above between the present invention and Dai as follows.

In the catalyst of the present invention, wherein an organic acid and a Group 8 metal form a complex on the catalyst, the layer structure of molybdenum disulfide is well developed since the Group 6 metal (for example, molybdenum) is first sulfided at the preliminary sulfidation step. Thereafter, the complex compound consisting of the Group 8 metal and an organic acid gradually decomposes whereby the CoMoS phase and NiMoS phase, which are desulfurization active sites, are effectively formed throughout the entire rim-edge portion of MoS, thus enabling ultra-deep desulfurization of gas oil.

In contrast thereto, in the catalyst of Dai, in which the Group 8 metal does not form a complex compound, since the Group 6 metal and the Group 8 metal are sulfided simultaneously at the preliminary sulfidation step, formation of Co₉S₈ species, Ni₃S₂ species, etc., which are inactive forms of cobalt or nickel, is expected while the CoMoS and NiMoS phases, both acting as desulfurization active sites, are not sufficiently formed. Accordingly, the desulfurization activity of the catalyst of Dai is not intended to reach the level of ultra-deep desulfurization achieved by the present invention.

In contrast to the fact that the desired desulfurization level for the present invention is so-called ultra-deep represented by the sulfur content in the resulting oil of 50 ppm or less, Dai is considered to refer to desulfurization levels represented by the sulfur content in the starting material which apparently is on the order of 5% (see, col. 8, line 54, for example), and which only results in percent sulfur removal on the order of say 57.7-65%. See TABLE at col. 11, lines 40-50 of Dai. Thus, the desired desulfurization levels are completely different and it is

reasonable to conclude that the desulfurization activity of the catalyst according to the present invention is far superior to that of the catalyst of Dai.

Claim 6

With respect to claim 6, Applicants submit that the conditions of hydrotreatment set forth in the present claims are not disclosed in Dai and this deficiency is not remedied by the other cited references. Accordingly, one of ordinary skill in the art would not have been motivated to combine the references with a reasonable expectation of success in achieving the claimed invention. For this additional reason, claim 6 is distinguished over the art.

In view of the above, the cited references do not disclose, teach or suggest the presently claimed invention, whether taken alone or in combination. Accordingly, Applicants respectfully request withdrawal of the obviousness rejections.

Obviousness-type Double Patenting Rejections

Claims 1-6 are provisionally rejected on the ground of non-statutory obviousness-type double patenting over claims 1, 4, 5, 7 and 8 of copending Appln. No. 10/344,317 ('317 application).

Applicants treat the rejection as though it were not provisional, and traverse as follows.

First, as the Examiner will appreciate, the claims herein have the minimum average pore diameter is 96 Å. Referring to the claims of the '317 application, the maximum pore diameter is 95 Å.

Thus, there is literal difference between the present minimum average pore diameter claimed in the present application and that claimed in the '317 application.

In this regard, Applicants have carefully amended the specification so that former Example 12, Catalyst L is now Comparative Example 8, Catalyst L. This is because the average

pore diameter in the claims is restricted and Catalyst L is outside of the scope of the amended claims.

The present invention is an improvement on the invention of the '317 application. Referring to the specification of the '317 application, in the paragraph bridging pages 21-22, it is seen that the average pore diameter is an important factor in the success of the catalyst of the '317 application. Note especially the discussion at page 22, lines 2-7, where it is stated:

“When the average pore diameter thereof is larger than about 95 Å, the catalyst has a reduced internal-surface area of the pores although diffusion into the pores is satisfactory. The catalyst hence has a reduced effective specific surface area and reduced activity.”

Comparing that discussion to the discussion at page 21, last five lines on page 22, lines 1/2, it is seen that while there is some leeway at the lower end of the average pore diameter range of the '317 application, the upper range of the average pore diameter is an important parameter.

There is no suggestion in the '317 application of using pore diameters larger than 95 Å. None of the working examples in the '317 application appear to contemplate an average pore diameter greater than 95 Å.

Thus, construing the claims of the '317 application in light of the teaching in the specification of the '317 application, there is no suggestion to use a larger average pore diameter.

Turning now to the present application, though Applicants own specification cannot be used against them, at page 19, second full paragraph, there is a teaching against using small pore diameters. The similar effect is the present specification and the paragraph bridging pages 26-27. Applicants thus respectfully submit that given the very precise nature of the claims as limited at the average pore diameter and the contrary teaching in the '317 application, one of

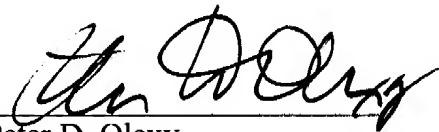
ordinary skill in the art would not find the claims of the present application to be obvious over the claims of the '317 application and request withdrawal.

With respect to the provisional obviousness-type double patenting rejection over claims 1,4 and 7 of co-pending application No. 10/594,451, since this rejection is only provisional, Applicants do not comment thereon at this time.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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